

WHAT IS CLAIMED IS:

- 1 1. A method for improving performance of an audio chip including a DSP, comprising the
2 steps of:
3 providing an apparatus having a plurality of elements running in parallel with said
4 DSP;
5 configuring said apparatus to perform a function according to a configuration setup;
6 and
7 employing said apparatus for accessing data from said elements in a pipeline
8 structure to maximize utilization of said elements.
- 1 2. The method of claim 1 wherein said function is usable in audio algorithms.
- 1 3. The method of claim 1 wherein said function is selected from a group consisting of
2 biquad filtering, double precision biquad filtering, IFFT, IDCT, pre-multiplication, and
3 post-multiplication.
- 1 4. The method of claim 1 wherein said plurality of elements includes:
2 a first memory for storing real part data;
3 a second memory for storing imaginary part data;
4 a third memory for storing coefficient data;
5 a multiplier for processing said real part data, said imaginary part data, and said
6 coefficient data; and

7 an ALU for processing said real part data, said imaginary part data, and said
8 coefficient data.

1 5. The method of claim 1 wherein in a post-multiplication function, data is accessed in bit-
2 reverse order.

1 6. The method of claim 1 wherein data is accessed in a four-cycle pipeline structure in a
2 pre-multiplication function, in an IFFT function, and in a post-multiplication function, data
3 is accessed in a six-cycle pipeline structure in a biquad mode, and data is accessed in a
4 nine-cycle pipeline structure in a double precision biquad mode.

1 7. The method of claim 1 wherein performing a biquad function comprises the steps of:
2 receiving $N + 1$ samples of data x_n for $n = m$ to $n = m + N$;
3 storing data including said samples of data in memory locations in a predefined
4 order; and
5 calculating y_n according to the equation $y_n = b_0x_n + b_1x_{n-1} + b_2x_{n-2} + a_1y_{n-1} + a_2y_{n-2}$.

1 8. The method of claim 7 wherein said predefined order comprises: y_{m-2} in a location K ,
2 y_{m-1} in a location $K + 1$, x_{m-2} in a location $K + 2$, x_{m-1} in a location $K + 3$, and x_m to x_{m+N} in
3 location a $K + 4$ through a location $K + N + 4$.

1 9. The method of claim 8 wherein the step of calculating y_n comprises the steps of:

2 (i) using values of y_{m-2} , y_{m-1} , x_{m-2} , x_{m-1} and x_m in respective locations K , $K + 1$, K

3 $+ 2$, $K + 3$, and $K + 4$ to calculate a y_m ;

4 (ii) storing said y_m in said location $K + 2$;

5 (iii) incrementing m by 1;

6 (iv) incrementing K by 1; and

7 (v) returning to step (i).

1 10. The method of claim 1 wherein performing a double precision biquad function

2 comprising the steps of:

3 receiving $N + 1$ samples of data x_n for $n = m$ to $n = m + N$;

4 storing data in memory locations in a predefined order; and

5 calculating y_n according to equation $y_n = b_0x_n + b_1x_{n-1} + b_2x_{n-2} + a_1yl_{n-1} + a_2yl_{n-2} +$

6 $a_1yh_{n-1} + a_2yh_{n-2}$.

1 11. The method of claim 10 wherein said predefined order comprises: yh_{m-2} in a location

2 K , yh_{m-1} in a location $K + 1$, yl_{m-2} in a location $K + 2$, yl_{m-1} in a location $K + 3$, x_{m-2} in a

3 location $K + 4$, x_{m-1} in a location $K + 5$, and x_m to x_{m+N} in a location $K + 6$ through a

4 location $K + N + 6$.

1 12. The method of claim 10 wherein the step of calculating y_n comprises the steps of:

2 (i) using values of $y_{h_{m-2}}$, $y_{h_{m-1}}$, $y_{l_{m-2}}$, $y_{l_{m-1}}$, x_{m-2} , x_{m-1} and x_m in respective

3 locations K , $K + 1$, $K + 2$, $K + 3$, $K + 4$, $K + 5$, and $K + 6$ to calculate a y_m ;

4 (ii) storing a y_{h_m} and a y_{l_m} of said y_m in said locations $K + 2$ and $K + 4$

5 respectively;

6 (iii) incrementing m by 1;

7 (iv) incrementing K by 1; and

8 (v) returning to step (i).

1 13. A method for performing a biquad function comprising the steps of:

2 receiving $N + 1$ samples of data x_n for $n = m$ to $n = m + N$;

3 storing data in memory locations in a predefined order; and

4 calculating y_n according to the equation $y_n = b_0x_n + b_1x_{n-1} + b_2x_{n-2} + a_1y_{n-1} + a_2y_{n-2}$.

1 14. The method of claim 13 wherein said predefined order comprises: y_{m-2} in a location K .

2 y_{m-1} in a location $K + 1$, x_{m-2} in a location $K + 2$, x_{m-1} in a location $K + 3$, and x_m to x_{m+N} in a

3 location $K + 4$ through a location $K + N + 4$.

1 15. The method of claim 14 wherein the step of calculating y_n comprises the steps of:

2 (i) using values of y_{m-2} , y_{m-1} , x_{m-2} , x_{m-1} and x_m in respective locations K , $K + 1$,

3 $K + 2$, $K + 3$, $K + 4$ to calculate a y_m ;

4 (ii) storing said y_m in said location $K + 2$;

5 (iii) incrementing m by 1;

6 (iv) incrementing K by 1; and

7 (v) returning to step (i).

1 16. A method for performing a double precision biquad function comprising the steps of:

2 receiving $N + 1$ samples of data x_n for $n = m$ to $n = m + N$;

3 storing data including said samples of data in memory locations in a predefined

4 order; and

5 calculating y_n according to the equation $y_n = b_0x_n + b_1x_{n-1} + b_2x_{n-2} + a_1yl_{n-1} + a_2yl_{n-2}$
6 $+ a_1yh_{n-1} + a_2yh_{n-2}$.

1 17. The method of claim 16 wherein said predefined order comprises: yh_{m-2} in a location

2 K , yh_{m-1} in a location $K + 1$, yl_{m-2} in a location $K + 2$, yl_{m-1} in a location $K + 3$, x_{m-2} in a

3 location $K + 4$, x_{m-1} in a location $K + 5$, and x_m to x_{m+N} in a location $K + 6$ through a

4 location $K + N + 6$.

1 18. The method of claim 17 wherein the step of calculating y_n comprises the steps of:

2 (i) using values of yh_{m-2} , yh_{m-1} , yl_{m-2} , yl_{m-1} , x_{m-2} , x_{m-1} and x_m in respective
3 locations K , $K + 1$, $K + 2$, $K + 3$, $K + 4$, $K + 5$, and $K + 6$ to calculate a y_m ;

4 (ii) storing a yh_m and a yl_m of said y_m in said locations $K + 2$ and $K + 4$
5 respectively;

6 (iii) incrementing m by 1;

7 (iv) incrementing K by 1; and

8 (v) returning to step (i).